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A set of time series data labour market stocks and flows for the Netherlands 1980 to 2010

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A set of time series data labour market stocks and flows for the Netherlands 1980 to 2010

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A Set of Time Series Data Labour Market Stocks and Flows for the Netherlands 1980 to 2010

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Abstract:

In this paper we present data on flows in the labour market for the period 1980 – 2010, which have been constructed using various sources. The focus of our analysis is on four labour market states within the working age population of age 15 – 64: Employment, Unemployment, Not working and Disabled. A comparison is provided with the earlier studies of Broersma and den Butter (1994) and Kock (1998), and with the data published by the CBS from the labour force survey (EBB). The latter comparison is also used to indicate the presence of the time aggregation bias in the CBS data.

Key words: labour market flows, time aggregation bias, the Netherlands

JEL-code: J60, J63, J64, J82

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Data is available upon request.

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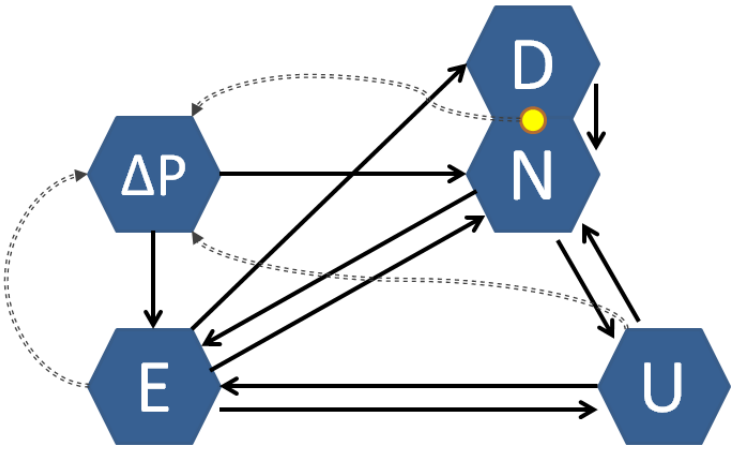
1 Introduction

In this paper we present data on flows in the labour market for the period 1980 – 2010, which have been constructed using various sources. The focus of our analysis is on labour market states within the working age population of age 15 – 64 (P): Employment (E), Unemployment (U), Not working (N) and Disabled (D).[1] The four labour market states are mutually exclusive, and except for disability, mostly unrelated to the corresponding social insurance. A given person may for example have the desire to work[2] and is actively seeking work, but does not receive unemployment benefits. In our framework, that person would be counted as unemployed.[3] We include disability separately as a category next to the not working population because it is a large category in the Netherlands. The resulting stocks and flows are summarized in Scheme 1, and outlined in Appendix 2.

Scheme 1 Stocks and flows on the labour market



Compared to earlier papers, this paper offers three contributions. Firstly this is the first paper to present worker flow data going back from the present to 1980, where we distinguish four states within the working age population of age 15 – 64. We deviated from the standard method of Davis and Haltiwanger (1992) where flows are measured as changes between discrete times,[4] and base ourselves on worker flows.

[1] Although originally planned, we did not include data on employed but receiving sickness benefits (S), since the flows from employment to receiving sickness benefits and vice-versa cannot be easily be made consistent over time due to (among others) a large-scale policy change in 1993.
[2] More than 12 hours, following the unemployment definition used in this paper.
[3] However, if this person is already working part-time for more than 12 hours, she will not be counted as unemployed. We elaborate on the various measures of unemployment in section 2.3.
[4] See Broersma and Gautier (1997) for an application to the Netherlands.

Secondly, we construct flows from and into unemployment combining duration characteristics of survey data and administrative flow data. This is an important difference with earlier contributions to the measurement of worker flows on the Dutch labour market such as Broersma and den Butter (1994) and Kock (1998), who only use the flows of benefit recipients from social insurances.

Thirdly, in contrast to various publications of the Dutch statistical agencies, the administrative data we are working does not compare the labour market position of workers between different points in time, but instead measures worker flows continuously, thereby overcoming the time aggregation bias outlined in Shimer (2012). For instance, this underreporting of the labour market mobility data occurs in the flow data published by the CBS since 2003.

The paper is organized as follows: Section 2 is describes the various stocks on the labour markets and the data sources used. In section 3 we then construct the various flows between these stocks, using data from different sources (we document carefully how we solved the various consistency problems). We compare our data on stocks and flows to those presented in Broersma and den Butter (1994) and Kock (1998) in section 4 and point out the differences. A comparison with the data provided by the CBS on flows on the labour market, both from the SSB and the LFS (EBB), is provided in section 5, which also gives an indication of the time aggregation bias in the CBS data. Section 6 concludes the paper.

2 Labour market stocks

Dutch labour market stock data is available from many different sources, like appendix 7 of the 2011 Macoecononomic Outlook (MEV) of the Netherlands Bureau for Economic Policy Analysis (CPB), the Statline database of Statistics Netherlands (CBS), and the 2011 "Statistische tijdreeksen UWV", which is the successor of the "Kroniek van de Sociale Verzekeringen" (and will therefore be referred to as "Kroniek"), published by the social insurance council, called "Uitvoeringsinstituut Werknemersverzekeringen" (UWV). We focus on the timeframe 1980 to 2010. An explanatory list of acronyms is provided in Appendix 1.

From 1987 onwards, the data published by the CBS and the CPB on labour market stocks is based on the Dutch Eurostat Labour Force Survey. The Labour Force Survey is based on a sample of the Dutch population that excludes the so-called institutional population, i.e. the share of the population that is unable to respond the questions asked in the survey for physical or psychological reasons. In 1987, new definitions on the labour force composition came into force. Prior to that change, the CBS worked with data from the Labour Force Surveys of 1981, 1983 and 1985. We used these sources to identify the various labour stocks of Scheme 1 in the introduction. In the scope of this data collection, we consistently used end of year data.[5] Finally, all data refer to persons, Dutch residents, of age 15 – 64. We discuss subsequently the development over time of population, age 15 – 64, employment, unemployment, the non-working labour force and disability.

2.1 Population age 15-64

Both the CPB and the CBS measure the amount of Dutch residents in the age category 15-64. The two working age population series are very similar. From 2003 on, monthly December data is used. From 1980 to 2003, the displayed CBS data is made compatible with end of year data using geometric means. The series is presented in Figure 1, together with the employment data, which we discuss in the next section.

[5] In this part of the paper, all figures are measured on an annual basis and in 1000's if not mentioned otherwise. Where only mid-year data is available, we used the geometric mean between mid-year points to construct end of year series. Using the geometric mean follows from our assumption of constant growth rates within a year.

Figure 1 – Population age 15-64 (x1000) and employment

Figure 2 – Employed labour force (x1000)

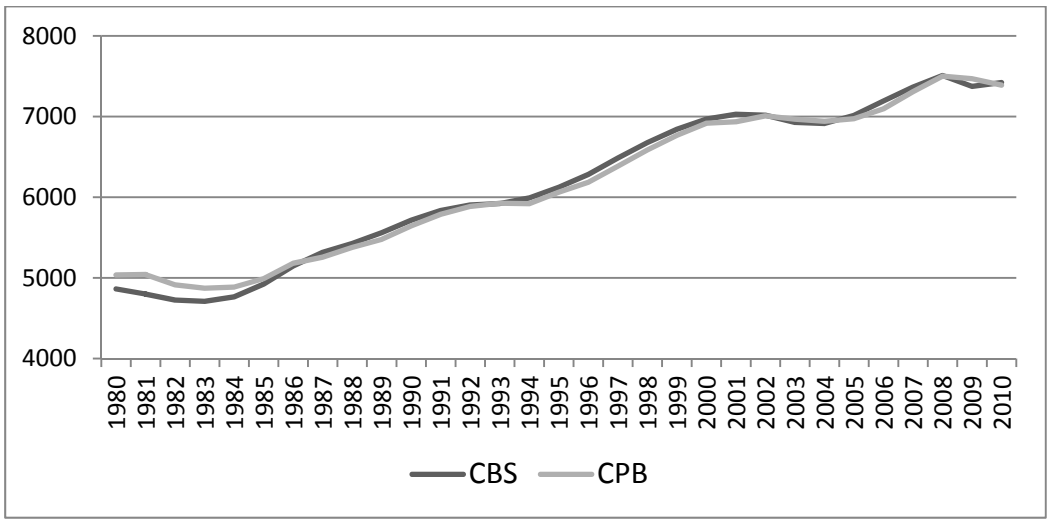
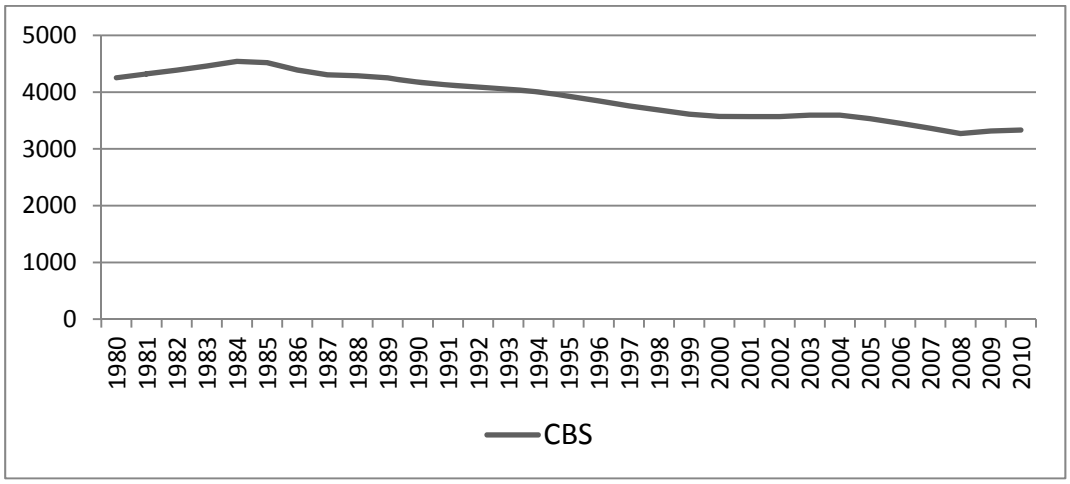


Figure 3 – Not working labour force (including disability) (x1000)



2.2 Employed labour force and non-working labour force

The employed labour force consists of persons that are working more than 12 hours per week. Until 2003, the data on employment from the CBS were measured on a mid-year basis[6]. The resulting series is presented in Figure 2. For reasons of comparison we also present the CPB data. The series is different from that of the CBS because the CPB incorporates workers older than 65 and non-Dutch citizens in their statistic. However, these differences are negligible.[7]

The series on the non–working labour force is constructed by subtracting both employment and unemployment (see the next section) from total population 15-64. The resulting series is presented in Figure 3. As due to increased participation, employment grew faster than working age population, the non-working labour force is declining since the mid-80s.

2.3 Unemployment

Contrary to measuring population figures, measuring unemployment accurately is not very trivial. Different measurements of unemployment differ due to differences in the underlying definitions of unemployment. In the Netherlands, there have been a huge number of different unemployment figures, available from different sources and over different time periods.

At the end of the 1970s, the official Dutch unemployment figure was defined as consisting of all persons that are looking actively for a job of more than 25 hours per week. This definition was replaced at the beginning of the 1980's. In 1981, the CBS discussed the introduction of an alternative measure for unemployment. One of the alternatives that were discussed was the so-called CCS81 definition. This new definition would lower the hour frontier from 25 to 20 hours per week, and add persons that are not "job-match-able" (Source: SWZ, 1993, Chapter 3). Thus, according to the CCS81 definition, persons had to be without work and available, not necessarily searching actively for work to be counted as unemployed.

[6] We transform these to end-of-year data using geometric means. From 2003 onwards we used the December observations.

[7] We cannot explain the difference between the two series in the time period 1980 – 1988, since information on the construction method of the CPB data is not available.

In the subsequent search for the new official unemployment definition, the ILO definition of looking for work and without job (WZB, "werkzoekende zonder baan"[8]) also played a role. However, the dominant alternative measure was the so-called "beroepszoekende zonder baan" (BZB), i.e. the total number of persons that are registered as unemployed with the unemployment office, including the persons that are unemployed but do not get a benefit. In the end, the BZB was introduced in 1983 as the national measure for unemployment.

In 1987, a discussion leading to another change in the official unemployment measure was initiated by the CBS and the Scientific Council for Government Policy (WRR), who argued that the BZB series, based on unemployment figures provided by the Labour Office (GAB), were overestimated by one third since persons who found jobs did not always notify the GAB. This led to the BZB being replaced by a measure called "geregistreerde werkloosheid" (also called GWL; see SWZ, 1988, ch.3), which basically consisted of the BZB numbers corrected by the CBS labour force survey ("enquête beroepsbevolking") for registration errors. The survey identifies persons that have less than twelve hours of paid work a week, and are actively looking for paid work.

Table 1: Different unemployment measures in 1987 (x 1000):

CCS81 definition	728
BZB „Beroepzoekenden zonder baan"	686
WZB „Werkzoekenden zonder baan" (ILO)	616
GWL „Geregistreerde werkloosheid"	456
WBB „Werkloze beroepsbevolking"	486
Eligible[9] for unemployment benefits	644
WW (Kroniek)	170
WWV (Kroniek)	62

The BZB was finally phased out in 1990. The definition that the CBS uses nowadays is the unemployed labour force (WBB, "werkloze beroepsbevolking"), i.e. persons who are willing to work at least 12 hours a week, who are available and actively seeking work for at least 12 hours a week. This series is similar to the GWL from 1998 onwards, although the numbers

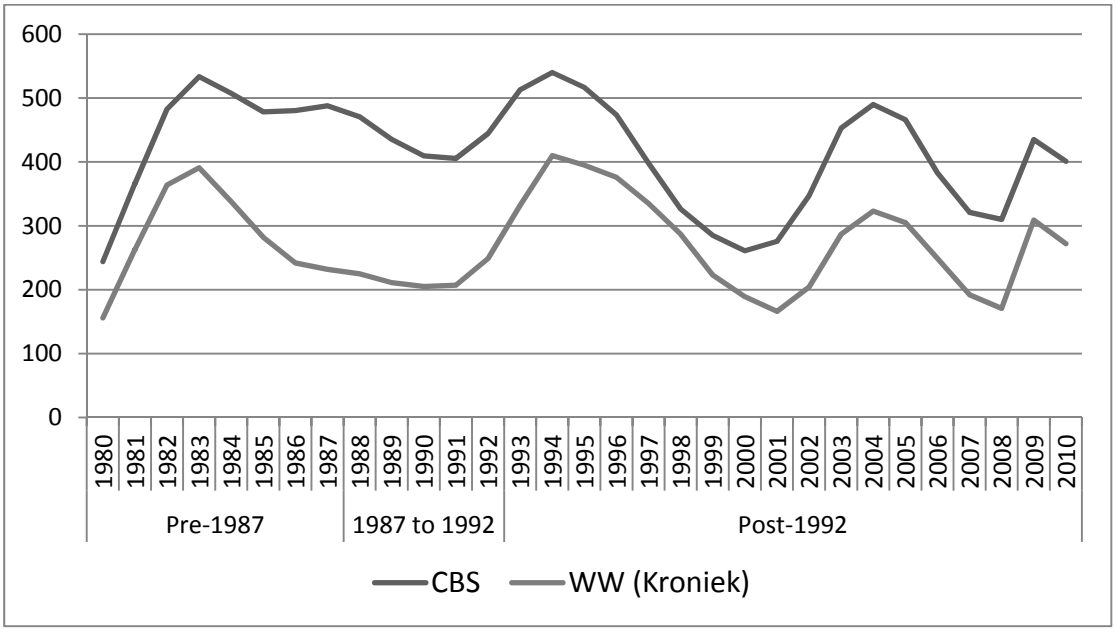
[8] The definition of WZB covers people belonging to the non-working labour force, except for those that are counted to the non-working labour force just because they are receiving an unemployment benefit, and for those that are (declaring to be) looking for a job but that are counted solely because they are registered as actively looking for work.

[9] But not necessarily receiving

differ to some small extent, probably due to differences in publication dates (1990 vs. 2006) and to revisions in the data. The various measures of unemployment are presented in Table 1 for the common year of overlap, i.e. 1987.

To be consistent with the most recent data we use the CBS unemployment (WBB) data. This time series is available over the whole period 1980 – 2010 (although measured on a mid-year basis)[10] – we present these in Figure 4.

Figure 4 – Unemployed labour force (x1000)



In order to compare our data with available flow data, we have to use administrative data on the number of unemployment benefit recipients (see also UWV or Kroniek), which we also present in Figure 4. The inflow and outflow of claimants is available for two benefits, the WW and the WWV. Table 1 shows that in 1987 the WW and WWV only constitute a relatively small part of those eligible as benefit recipients. The WW figure measures the number of persons that have been employed prior to becoming unemployed (so-called "ontslagwerkloosheid") and are entitled to an unemployment insurance benefit – if a person is still unemployed after six months, (s)he receives the WWV benefit (till 1987; thereafter

[10] We transform these to end-of-year data using geometric means prior to 2003. After 2003, we used real end-of-year data provided by the CBS. The Kroniek data were measured in December of each year.

the WWV is integrated in the WW). Furthermore, the participation to the WW(V) is limited in duration, depending on the previous employment history.[11]

The CBS definition of unemployment is much broader as we indicated above. Thus, the CBS unemployed labour force figure adds groups as diverse as school leavers looking for work, females re-entering the labour market and persons who have lost work without being entitled to an unemployment benefit according to the WW. This is even more important until 1992, when several other benefits were available to unemployed persons.[12] The latter explains why CBS and Kroniek unemployment become more parallel after 1992, as appears from Figure 4. Finally, long-term unemployment was more prevalent in the CBS series than in the WW(V) series, due to the limited duration of WW(V)-benefits. This also explains the large gap between the CBS series and the WW(V) series in Figure 4 in the mid-1980s, since many persons who flowed in during the early 1980s stayed unemployed. In section 3.2 we will explain how we use the flow data from the Kroniek (and other sources) to construct flow data for the broader unemployment (WBB).

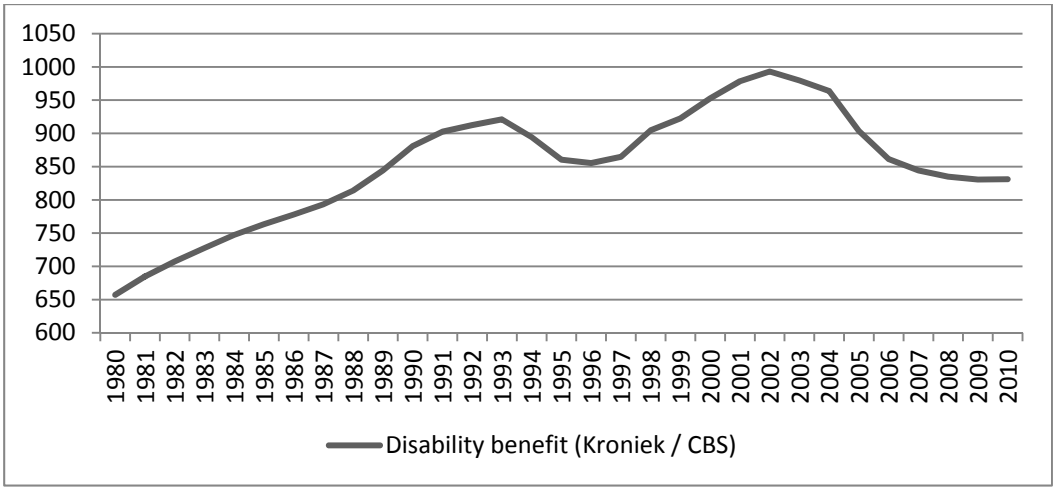
2.4 Disability

Data on persons receiving disability benefits are provided by the CBS and the UWV (both measured in December) and presented in Figure 5. They are based on administrative records of the disability insurance council and some of the corresponding company associations (i.e. the sectoral GAK ("Gemeenschattelijk administrator kantoor") offices, and include all forms of disability benefits, including the WAO, the WIA, the Wajong and the WAZ. Within our labour flow accounting model, disability is a part of the non-working population. To be consistent with the flow data published by the UWV, we will stick to using the UWV data, which is almost identical to the CBS data.

Figure 5 - Disability benefits (x1000)

[11] The minimal maximum benefit duration till 1987 was 6 months (when employed no more than 26 weeks over the past year) and the largest maximum duration is 2,5 years for persons of 48-53 years and an employment history of at least 5 years; 3,5 years for the age category 53 – 58 and 4 years in case of 58+.

[12] Moreover, due to a labour market reform in 1987, the 1988 – 1991 Kroniek data does not fully contain the WWV recipients and the benefit recipients of the unemployment insurance for civil servants. Both are integrated after 1992 into the WW, with small effects on overall stocks.



3 Labour market flows

This section is devoted to construct the labour market flows identified in Scheme 1 in the introduction. We will rely on both the Kroniek[13] and the CBS Statline database as source for our data. The latter is based on a large amount of different flow series published by the CBS in the scope of their Standaard Bedrijfsindeling 2008 (SBI) program. Since this data captures flows between different social insurance administrations, it will be used in this section to validate some of the assumptions used to construct flow data.

3.1 Entry and exit into and out of the population 15 – 64 and retirement

In the context of this paper, persons that become 15 years old and immigrants are the entrants into the working age population, which is the object of analysis. We assume that all persons that turn 15 as well as 2/3 of all immigrants enter into N – see R^{PN} in Scheme 1. The remaining 1/3 of all immigrants are assumed to enter employment E directly – see R^{PE} in Scheme 1.[14]

We used the CBS data on population by age and the yearly change in the working age population to construct both inflow and outflow, which is calculated as the residual. Outflow is assumed to consist of persons that become 65, deaths in the age group 15–64,

[13] Kroniek van de Sociale Verzekeringen, a yearly publication published by the social insurance council, called "Uitvoeringsinstituut Werknemersverzekeringen" (UWV). Since 2008, the name of this publication has changed to "Statistische tijdreeksen UWV"

[14] Using data from INDIS, the information system of the immigration and nationalization Service of the Dutch Ministry of the Interior and Kingdom relation, we found that a surprisingly constant 1/3 of the immigrants that moved to the Netherlands in the time period 1999 to 2005 entered the labor market directly. We thus believe it is safe to assume this share to hold for the whole time period 1980 to 2005.

and emigrants. The resulting entry and exit rates as percentage of the working age population are illustrated in Figure 6.

From the figure, one sees that the exit rate fluctuates between 2 and 3,25 per cent.[15] The figure also illustrates the demographic change in the Netherlands over the period. It becomes apparent that population growth has mainly slowed down after 2000 due to rises in the exit rate, which is due to increases in emigration and changes in demographics.

Figure 6 – Entry and exit as percentage of the population 15 – 64

Absent detailed information on outflow per state, we assume the persons belonging to whatever state of the labour force and who retire to be proportional to overall exit from the labour force, which is a fraction *r*. Hence:

$$R^{NP} = r\,N$$
$$R^{UP} = r\,U \qquad (1)$$
$$R^{EP} = r\,E$$
$$R^{DP} = r\,D$$

Thus exit is divided proportionally across all states.

[15] Assuming a flat distribution of age among the population 15-65 years old and no population growth, one would expect entry and exit rates of 2% each (1/50). Note that the figures are higher than the expected 2% due to immigration and emigration, which is also captured in the series.

3.2 Unemployment in- and outflow

In the Netherlands, flow data on registered unemployment are not systematically available – they are only available for unemployment benefit recipients. We construct flow data from administrative data to overcome the time aggregation bias, i.e. the consistent underreporting of the labour market mobility data due to the measurement method, which only compares the differences between two points in time. In section 5 we compare our data to existing series. This comparison will serve as an indication of the size of the time aggregation bias.

In this section we construct data on the inflow and outflow of registered unemployment ("werkloze beroepsbevolking", WBB) using flow data of unemployment benefit recipients (WW(V)) taken from UWV (2010) for the whole period 1980 – 2010.

As we explained in Section 2.3 and Figure 4, there are several discrepancies between the CBS (total unemployment) and the Kroniek (benefit recipient) data. Hence, we cannot simply project the inflow data from Kroniek on the CBS figures. However, we believe it is reasonable to assume that the inflows are proportional to the relevant stocks.[16] But since the Kroniek data is truncated in duration, it is not possible to simply compare the total stock of WBB unemployment with the total stock of Kroniek unemployment. Since the WW and WWV programs reflected in the Kroniek data allowed the recipiency of unemployment benefits for about a year, it seems reasonable, however, to assume that the stocks are comparable for short unemployment durations. To construct the relevant stocks we had to use several data sources. We summarize the sources necessary to construct the inflow data in Table 2 and discuss the steps we follow below.

Table 2 - Construction of short term flow data for WW and WBB unemployment

Time frame WBB	**Total unemployment**	**Benefit recipients**	**Time frame WW**
	WBB stock	*WW stock*	
1980 - 1986	BZB < 6 months	WW < 6 months	1980 - 1986
1987 - 2000	GWL < 12 months	Kro < 12 months (outflow)	1987 - 1997
2001 - 2010	WBB < 12 months	Kro <12 months	1998 – 2010

[16] In a steady state situation with no limit on Kroniek duration, this would imply that we assume that the duration of unemployment is similar for the CBS and the Kroniek. For, in the steady state unemployment duration can be approximated by the ratio of the volume of unemployment to its inflow.

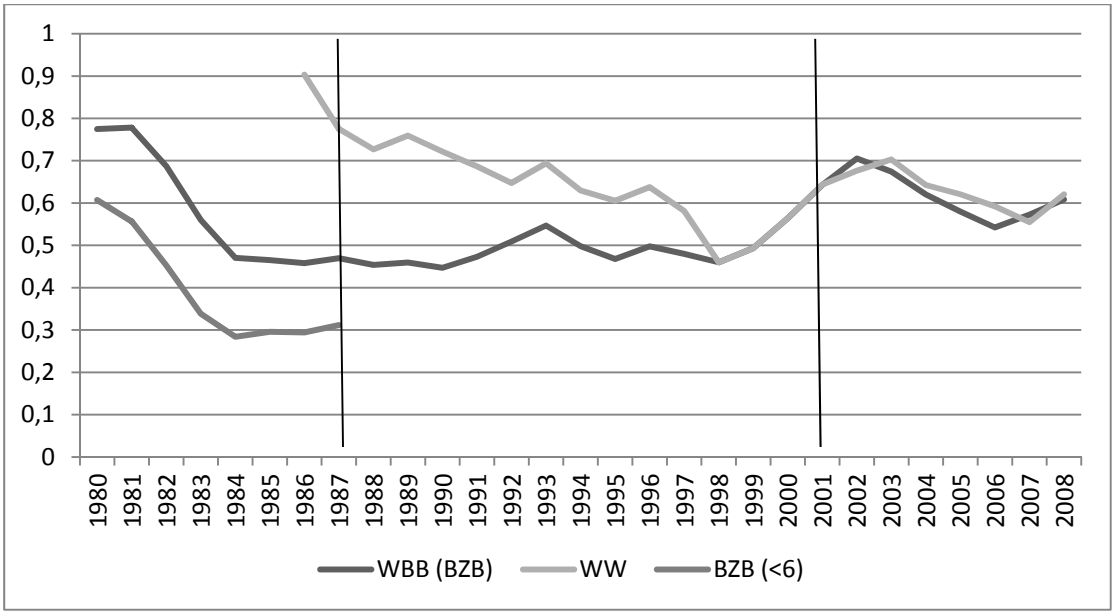
The CBS publishes the inflow of short-term unemployed (< 12 months) for the WW-data for the period 1998 – 2010, and for the WBB-data (registered unemployment) for the period 2001 – 2010. Hence for the overlapping period 2001 – 2010 equation (2a) can be applied directly. This implies that we construct the inflow in WBB unemployment for the years 2001 to 2010 from:

$$I_{01-10}^{U,WBB} = I^{U,Kro} \frac{U_{<12}^{WBB}}{U_{<12}^{Kro}} \qquad (2a)$$

where I^U refers to the inflow, U^{WBB} refers to the volume of WBB unemployment and the variables with the subscript "Kro" both refer to the Kroniek data. For 1998 – 2001, the unemployment stock used is larger than just the administrative UWV count of benefit recipients. As the flows are based on the benefit recipients only, there must be a correction factor > 1. Since the GWL is parallel and deviates less than 7% to the WBB in the period 1998 to 2001, we use the same equation using the GWL for these years, with the correction factor U^{WBB}/U^{GWL}. Accordingly,

$$I_{98-01}^{U,WBB} = I^{U,Kro} \frac{U_{<12}^{GWL}}{U^{GWL}} \frac{U^{WBB}}{U_{<12}^{Kro}} \qquad (2b)$$

Figure 7 - Share of short-term unemployment in total unemployment[17]



[17] Post-2008 data not available at the time of writing

For the period prior to 1998, data are available on the share of short-term unemployed for the GWL unemployment. However, there are no data available on the share of short-term WW unemployment. In order to construct these figures we first use data on outflow from the WW according to duration, published by Kroniek since 1987. We used the fact that outflow of duration of 1 year or more should reflect long-term unemployment for the previous year. The remaining unemployment beneficiaries then are short-term unemployed. This notion allows us to construct the share of short-term WW unemployment for the period 1987 – 1998. Then equation (2b) can also be applied for that period. From Figure 7 we see that the shares of short-term unemployment is quite close to the share published by the CBS, which we have used from 1998 onwards, and to a higher share of short-term WW unemployed prior to 1998. From Figure 4 one sees that this shift also follows the large reduction in unemployment after 1996.

In the period prior to 1987 the maximum duration of the WW was six months. Hence the relevant stock refers to the unemployed less than six months. Unfortunately we didn't have these data available for the WBB stock, but they are available for the BZB stock. We assume that the proportion of persons less than 6 months in the BZB unemployment is similar to that in WBB unemployment – Figure 7 shows that the share of short-term unemployment (< 1 year) in BZB fits very well to the share in GWL for later years since there is no noticeable break after 1986. This enables us to construct the relevant stock of WBB unemployed for less than 6 months, and then apply equation (2c) to the WW data of the Kroniek, with the correction factor U^{WBB}/U^{BZB}. The high shares in short-term unemployment in the years 1980 and 1981 follow from the strong increase in unemployment during those years – see also Figure 4[18].

$$I_{80-87}^{U,WBB} = I^{U,Kro} \frac{U_{<6}^{BZB}}{U^{BZB}} \frac{U^{WBB}}{U_{<6}^{Kro}} \qquad (2c)$$

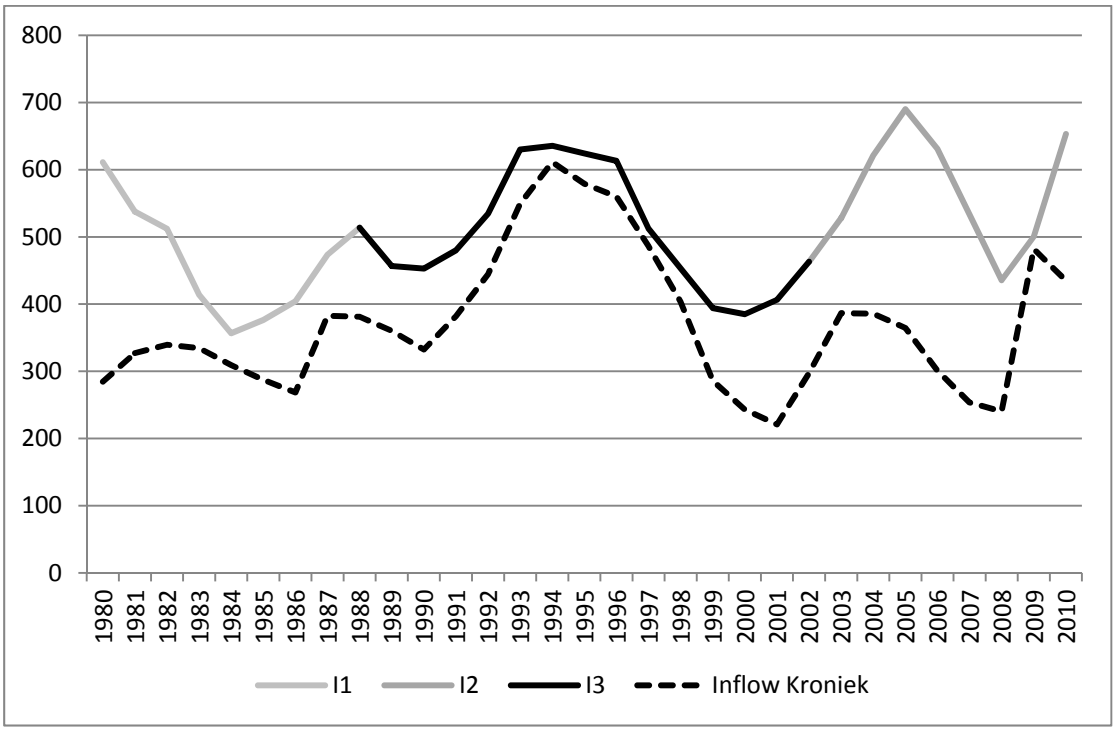
One can infer from Figure 7 how the share of short-term unemployment in total unemployment has evolved over time. The duration increased sharply, following the oil crisis in 1979 – see also the huge increase in unemployment in Figure 4. Duration started to decline again after 1983, when unemployment stabilized and recovery of the economy set in. The recessions in the early 1990's and the early 2000's are characterized by an increase in unemployment duration.

[18] The same holds for long term unemployment since long term unemployment and short term unemployment are linked to each other via total unemployment. For convenience, we will focus solely on short term unemployment.

The constructed inflow data is presented in Figure 8, together with the Kroniek data. The different time frames identified in Table 2 are also illustrated in the Figure, thereby splitting the inflow series into I1, I2, and I3. One sees that both series are in particular close to each other when inflow is high in the mid-1990s. That is not surprising because unemployment duration was relatively low in those years. The outflow O^U is calculated recursively from the change in volume minus inflow, i.e.

$$\Delta (R^{UE} + R^{UD} + R^{UN} + R^{UP}) = \Delta U - (R^{EU} + R^{DU} + R^{NU}) \qquad (3)$$

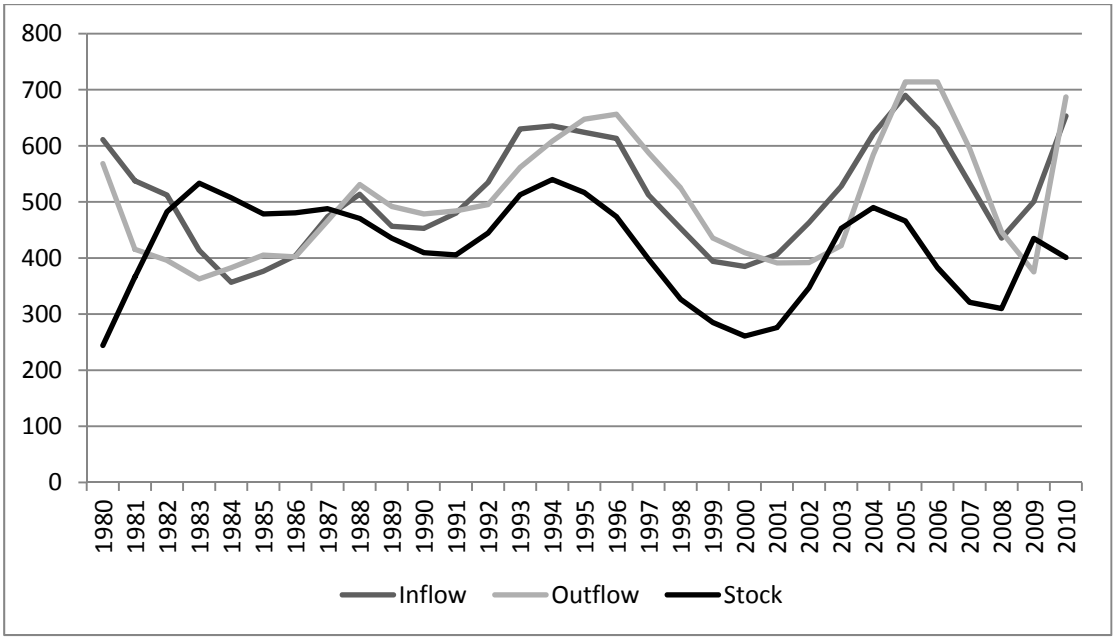
Figure 8 - Inflow in unemployment (WBB and WW)



According to equations (2) and (3), we calculated both inflow and outflow of WBB unemployment relative to the stock of unemployment, and present these in Figures 9 and 10, respectively.

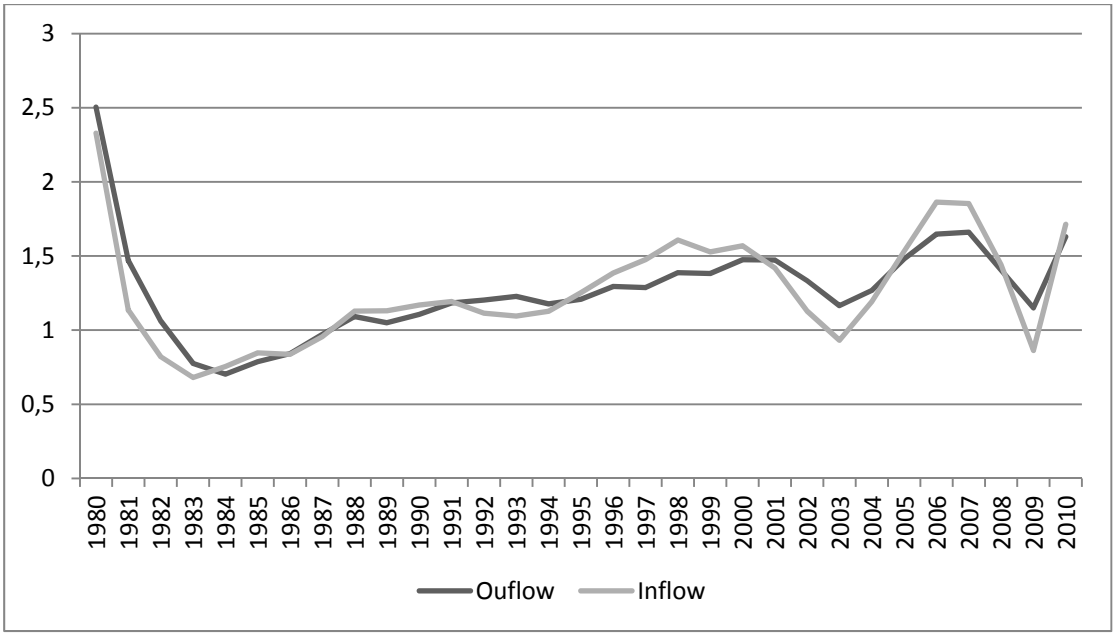
Figure 9 Inflow and outflow in WBB unemployment, absolute[19]

[19] We left out the observations for 1980 which correspond to rates of 2.50 and 2.36 for inflow and outflow respectively. These rates reflect the enormous increase in unemployment in 1980-1, see also Figure 4.



From Figure 9 one can see that inflow and outflow into and from unemployment follow movements comparable to the development in unemployment over time. As we illustrate in Figure 10, this relation is not stable. Inflow and outflow are both becoming increasingly more volatile than the unemployment stock, with average inflow and outflow rates close to 0,7 in 1983, and close to 1,5 in 2007. The sharp fall in inflow and outflow rates prior to 1983 can be explained by the sharp rise in unemployment inflow in the early 1980's, which was unmatched by the outflow at that time and accompanied by a rise in unemployment stocks. The relatively high level of these rates in general can be attributed to the time aggregation bias, as we elaborate in Section 5 below.

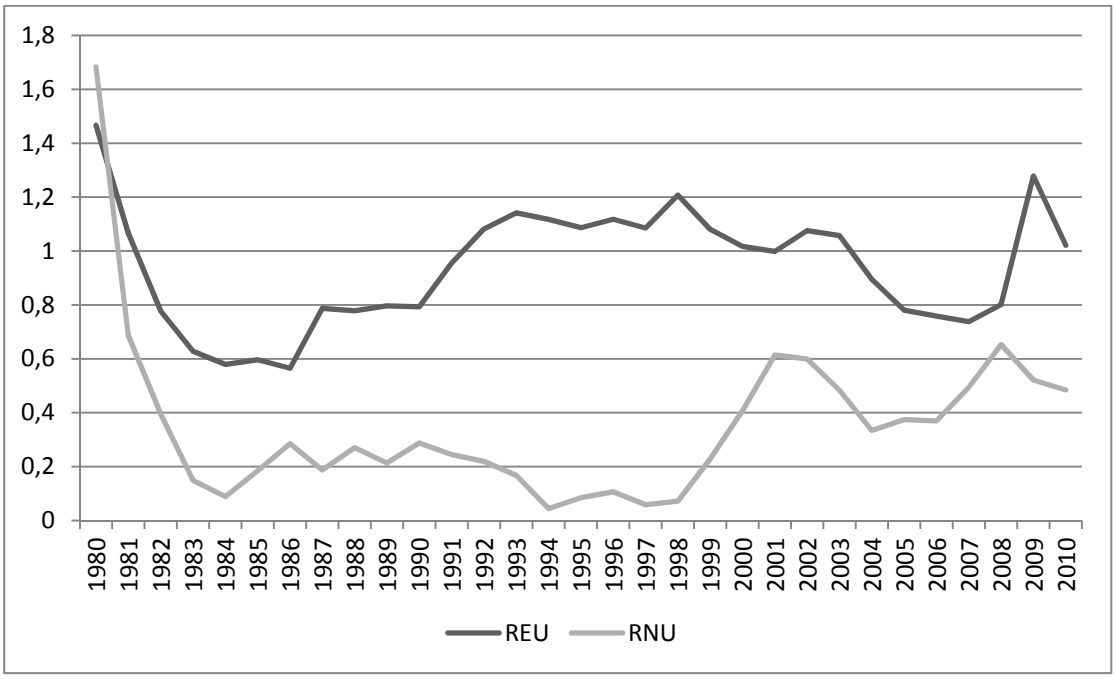
Figure 10 Rates of inflow and outflow in WBB unemployment (relative to U)



3.2.1 Decomposing unemployment inflow

We divide unemployment inflow I^U between R^{EU} and R^{NU} using equation (2), taking Kroniek inflow into "ontslagwerkloosheid" as R^{EU}, since this corresponds to the Inflow into unemployment from employment, and (3) calculating R^{NU} as $I^U - R^{EU}$. The resulting flow rates are presented in Figure 11. Since the flows between unemployment and employment are dominant in the flow model, it seems intuitively plausible that the outflow rate from employment to unemployment exceeds that from the non-working labour force to unemployment.

Figure 11 Flow rates R^{NU} and R^{EU} as share of unemployment stock



3.2.2 Decomposing unemployment outflow

The outflow from unemployment (O^U) is either to employment (R^{UE}), to retirement (R^{UR}) or to the non-working labour force (R^{UN}). Thus we find:

$$O^U = R^{UE} + R^{UP} + R^{UN} \qquad (4)$$

From equation (1) we know that exit is divided proportionally across all states with a rate *r*, and thus is R^{UP} is exogenous to unemployment outflow. Note that R^{UD} =0 for institutional reasons.

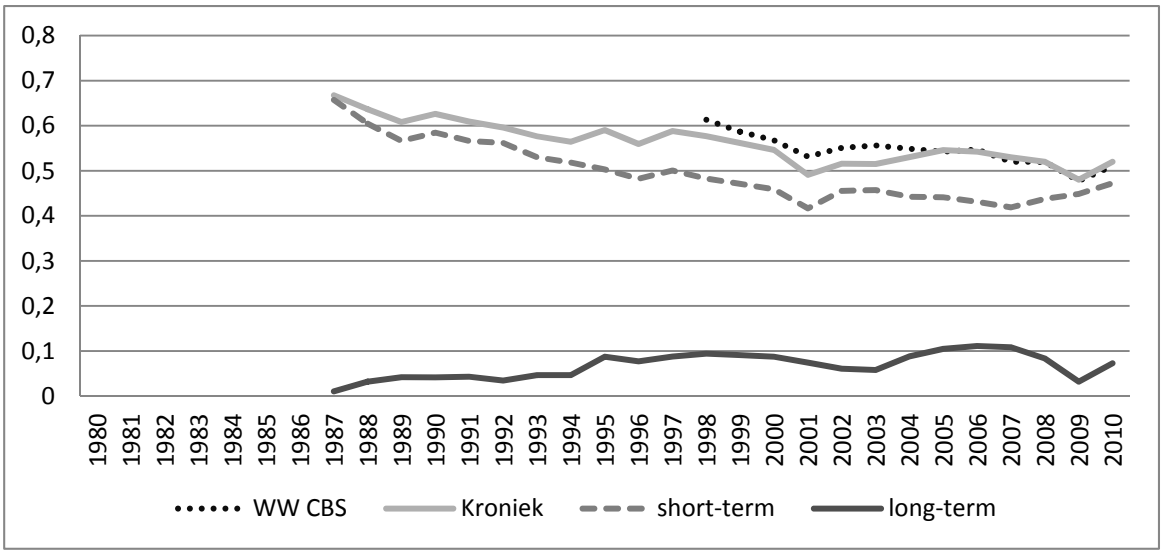
With respect to the remaining two other flows we again had to use data on inflow and outflow of unemployment benefit recipients (WW), which are distinguished in outflow to work and for other reasons. However, when transforming WW outflow data to work to WBB outflow data to work, we had to take into account again the truncation of the WW data. Since long-term unemployed are underrepresented in the WW and their probability to flow out of unemployment is low compared to short-term unemployed, we should correct for that feature in the transformation of the shares. Therefore we should also distinguish between short and long-term unemployment when looking at the outflow to work.

Table 3 Construction of outflow data from unemployment to work

	Outflow from unemployment to work	Short and long-term unemployment
1980 - 1986	Extrapolated BZB share, found in SWZ 1983-1985.	Assumed to be equal to the average share found in post-1987 Kroniek data on WW
1987 - 1997	Kroniek data on WW	Kroniek data on WW
1998 - 2010	Direct from Kroniek data on WW	No distinction

Table 3 summarizes the steps we take to construct the outflow data from WW to work in several steps.

Figure 12 Share of outflow back to work of short- and long-term unemployed



The CBS has published outflow from unemployment (WW) for two categories, “to work” and “other”, for the years 1998 – 2010. The proportion of outflow to work in total outflow of WWB unemployment, p^{UE}, is presented in Figure 12 as ‘WW CBS’. For the period 1998 – 2010 we then calculate outflow to work for registered unemployment, R^{UE}, from:

$$R^{UE} = p^{UE} O^{U} \qquad (5a)$$

Hence, using (4):

$$R^{UN} = (1-p^{UE}) O^{U} - R^{UR} \qquad (5b)$$

Unfortunately, the CBS has not published these outflow data prior to 1998. However, the Kroniek has published outflow from unemployment (WW) for both categories, "to work" and "other", for the years 1987 – 2010, where it also distinguishes between various categories of benefit duration. The latter enables us to distinguish between the share of outflow to work in total outflow of long and short-term unemployed persons.

These shares are presented in Figure 12, together with the overall share of outflow to work. From the figure one sees that the share of short-term unemployed in outflow to work decreases over time relative to total outflow, while the share of long-term unemployed increases modestly. As a consequence the overall share decreases too, at least till 2001. The overall share lies very close to the share observed by the CBS, which is consistent with the observation from Figure 7 that the duration structure of WW and WBB unemployment is comparable for that period. However, for the earlier period we should take difference in duration structure into account.

For that reason we use the following equation to transform the Kroniek outflow to work into the WBB outflow to work:

$$R_{WBB}^{UE} = O_{WBB}^{U}\left[\frac{\frac{U_S^{WBB}}{U_S^{WW}}R_{WW_S}^{UE}+\frac{U_L^{WBB}}{U_L^{WW}}R_{WW_L}^{UE}}{\frac{U_S^{WBB}}{U_S^{WW}}\left(R_{WW_S}^{UE}+R_{WW_S}^{UO}\right)+\frac{U_L^{WBB}}{U_L^{WW}}\left(R_{WW_L}^{UE}+R_{WW_L}^{UO}\right)}\right] \qquad (6)$$

In this equation $R_{XX_S}^{UE}$ and $R_{XX_L}^{UE}$ are the flows from short and long-term unemployment, respectively, to work; U_S^{XX} and U_L^{XX} are the corresponding stocks of unemployment. Since these need to be inflated to the right scale (WBB), the correction factors $\frac{U_S^{WBB}}{U_S^{WW}}$, $\frac{U_L^{WBB}}{U_L^{WW}}$,, $\frac{U_S^{WBB}}{U_S^{WW}}$ and $\frac{U_L^{WBB}}{U_L^{WW}}$ are necessary to ensure consistency of the division of flows over the total stock.

The corresponding share (WBB) is presented in Figure 13. One sees that this share is consistent with the Kroniek share from 1998 onwards, which is consistent with our observation from Figure 7 that the duration structure of unemployment is similar for both WW and WBB for that period.[20]

Finally the situation prior to 1987 is more complicated. We based outflow from WW to employment on BZB data for the period 1982 – 1985, obtained from the "Sociale Nota" for the years 1983, 1984 and1985. In addition, we assume the pre-1987 share of short term

[20] It therefore also validates the use of equation (6) for that period.

unemployment obtained from the WW series to be equal to the average value of post 1987 Kroniek data on WW[21]. In order to make the data available for the whole period, we extrapolated the series for the years 1980, 1981, and 1986 (see red marks in Figure 13). The new series is presented in Figure 13.

Equations (5) and (6) define the outflow from unemployment to employment R^{UE} over the period 1980 – 2010, equation (4) defines the outflow to retirement R^{UR}. The remaining outflow, R^{UN}, then follows from equation (5b). The outflow rates R^{UE} and R^{UN}, relative to the volume of unemployment, are presented in Figure 14.

Figure 13 - Share of outflow back to work in total outflow of unemployed.[22]

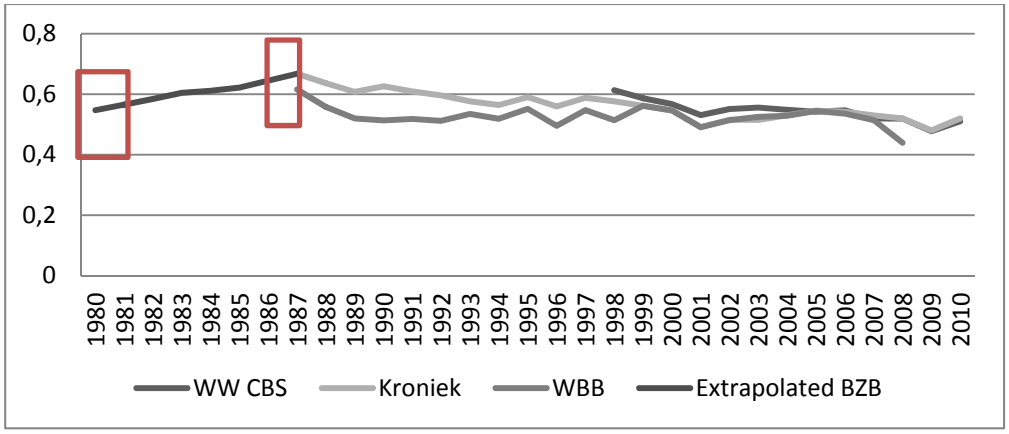
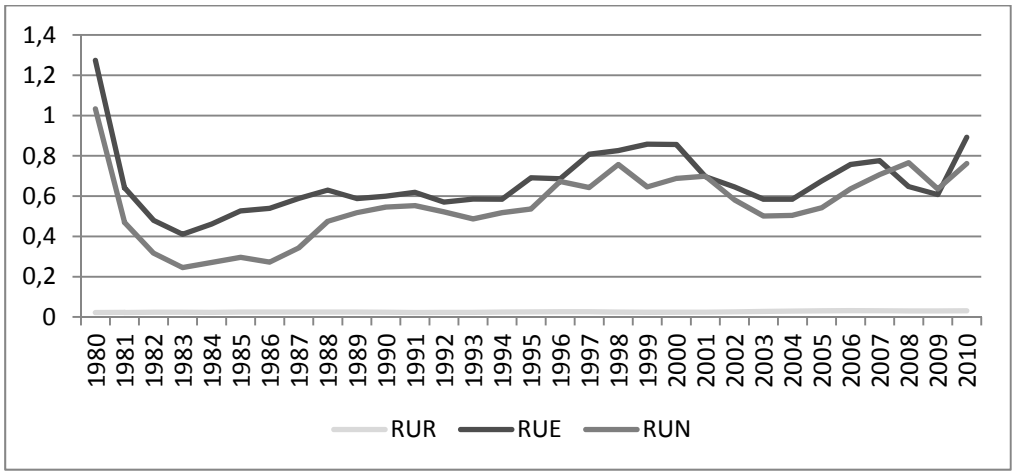


Figure 14 - Outflow rate of unemployment to employment and non-working as share of unemployment



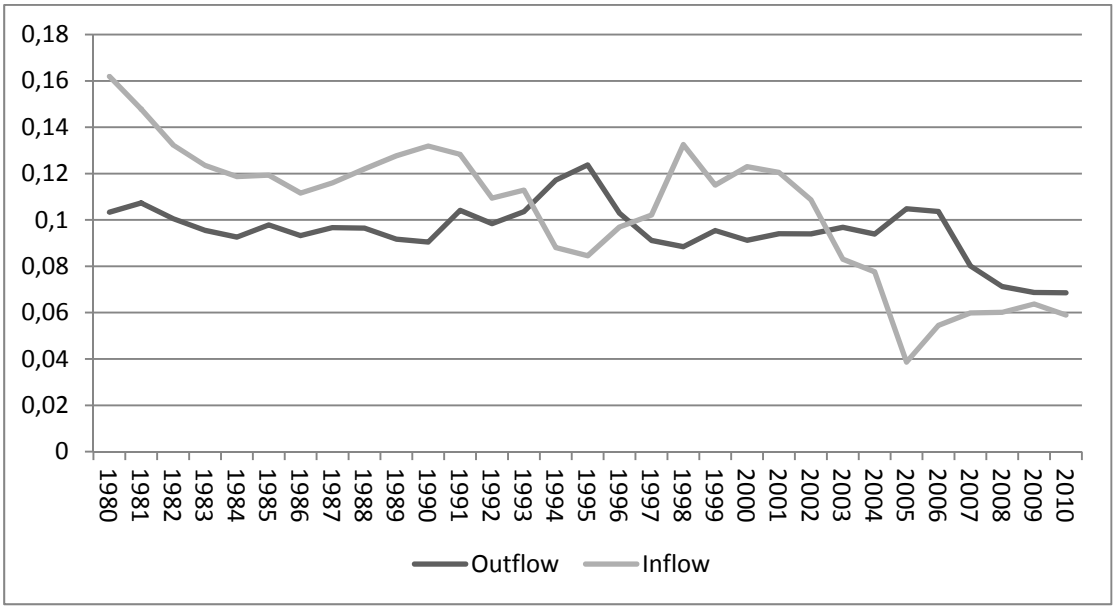
[21] for data stability reasons.

[22] Figure was adjusted for extrapolated pre-1987 outflow to work.

3.3 Inflow and outflow of disability

Since the Kroniek provides detailed information on disability in- and outflow, we will stick to the UWV data – see also Figure 5. The flow from employment to disability (through sickness) is based on the disability inflow data provided by the Kroniek. Figure 15 illustrates the disability inflow and outflow series obtained in this way.

Figure 15 – Disability outflow and inflow as a share of disability stock



3.4 Flows between the non-working labour force and employment

The outflow from the non-working labour force (O^N) is either to employment (R^{NE}), to retirement (R^{NR}) or to unemployment (R^{NU}). Since $R^{ND} = 0$, we have:

$$O^N = R^{NE} + R^{NP} + R^{NU} \qquad (7)$$

As argued in section 3.1, we assume that for the period 1999 -2005 one-third of all immigrants flowed into employment, whereas the remaining entrants ended up in not working. Since there is no data that allows a qualified statement on the number of immigrants entering employment in earlier years, we assume this ratio to be constant for the whole period.

Since the Kroniek gives the outflow from employment to unemployment, R^{EU},[23] it is sufficient to subtract R^{EU} and R^{PU} from total inflow in unemployment to calculate the remainder flow R^{NU}:

$$R^{NU} = I^{U} - R^{EU} - R^{PU} \qquad (8)$$

3.5 Flows between the non-working labour force and employment

From the discussion above we know R^{PE}, R^{DN}, R^{NU}, R^{UN}, R^{NP}, R^{PN}, R^{UE} and R^{EU}, while R^{EP} is defined analogous to equation (8). We also know the changes in the volumes of non-working labour force and of employment. The other flows R^{NE} and R^{EN}, then could in theory be solved both from the stock-flow equations for employment and non-working, i.e.

$$\Delta E = R^{EU} + R^{UE} + R^{NE} + R^{PE} - R^{EN} - R^{EP} - R^{EU} \qquad (9)$$

$$\Delta N = R^{PN} + R^{EN} + R^{DN} + R^{UN} - R^{NP} - R^{NE} \qquad (10)$$

In theory, equations (9) and (10), could be used to determine the size of the net flow from N to E, i.e. $R^{NE} - R^{EN}$. Due to small imperfections in the flow data and some discrepancies in the large number of data sources, the model does not "close" as predicted by theory. That is, the net flow $R^{NE} - R^{EN}$ required to "close the model" slightly differs between equations (9) and (10).

[23] To account for the inflow of self-employed into unemployment, we adjusted the unemployment due to firings flow from employment to unemployment by a factor of 1,035. We derived this factor from the SBI data. The Figures on self-employment are provided by CBS Statline prior to 1996, and by the CPB post-1994. We took averages in the overlapping years.

Figure 16 – Required net flow REN – RNE using different equations

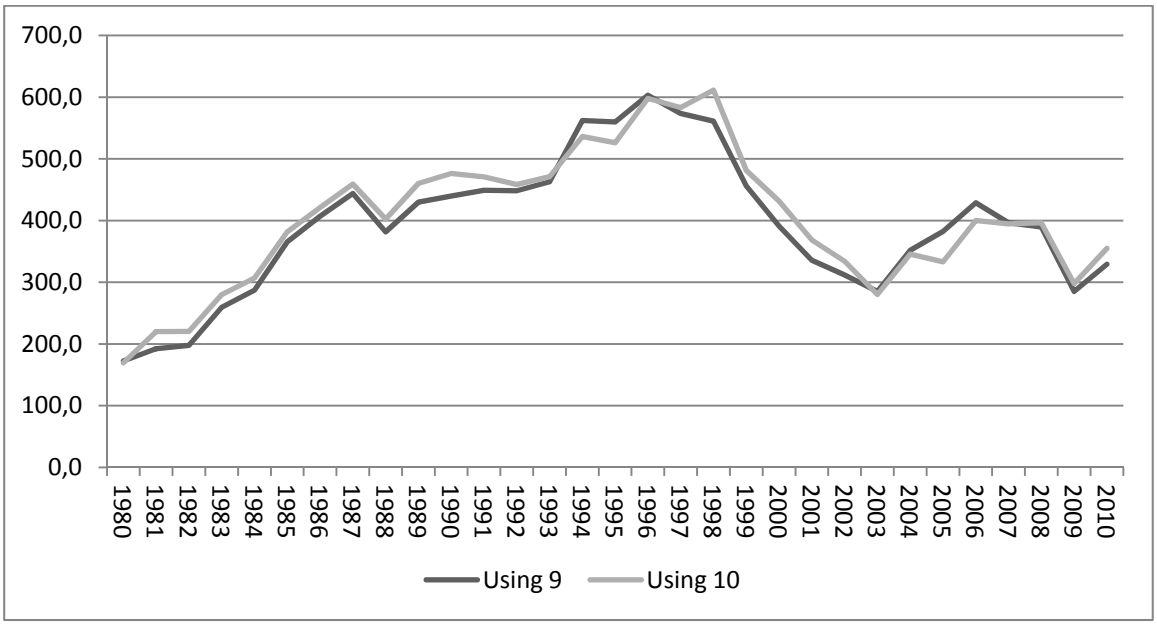


Figure 17 illustrates that difference. Note that since this difference is very small, we are confident that the model is working. Contrary to the analyses of den Butter and Kock (1998), who are shifting their discrepancies in N, we shift them into P, by deducting the different between the average of both series and the series from R^{PN} and R^{PE}. The second issue is that a clever division over the subcomponents R^{NE} and R^{EN} is not possible. However, since the net flow between E and N already contains sufficient information for our purpose, we will stick with it.

The resulting $R^{NE} – R^{EN}$ series is illustrated in Figure 17. Note that the difference between the two series is equal to the difference between the equivalent series in SBI (CBS, 2008). Figure 18 illustrates the $R^{BN} + R^{BE}$ series adjusted for the discrepancies determined in this paper.

Figure 17 – $R^{NE} – R^{EN}$ series adjusted for discrepancies in model

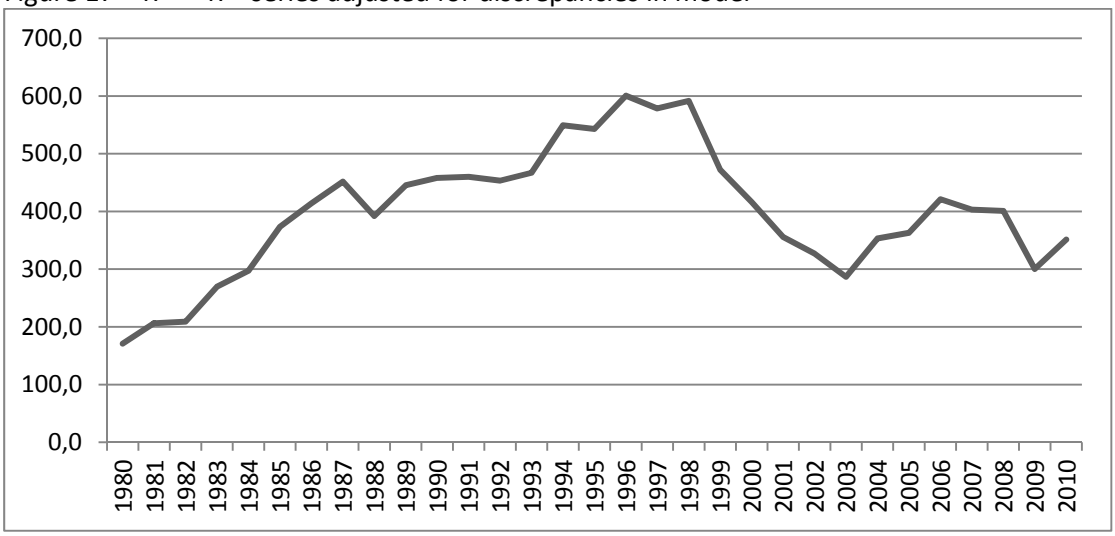
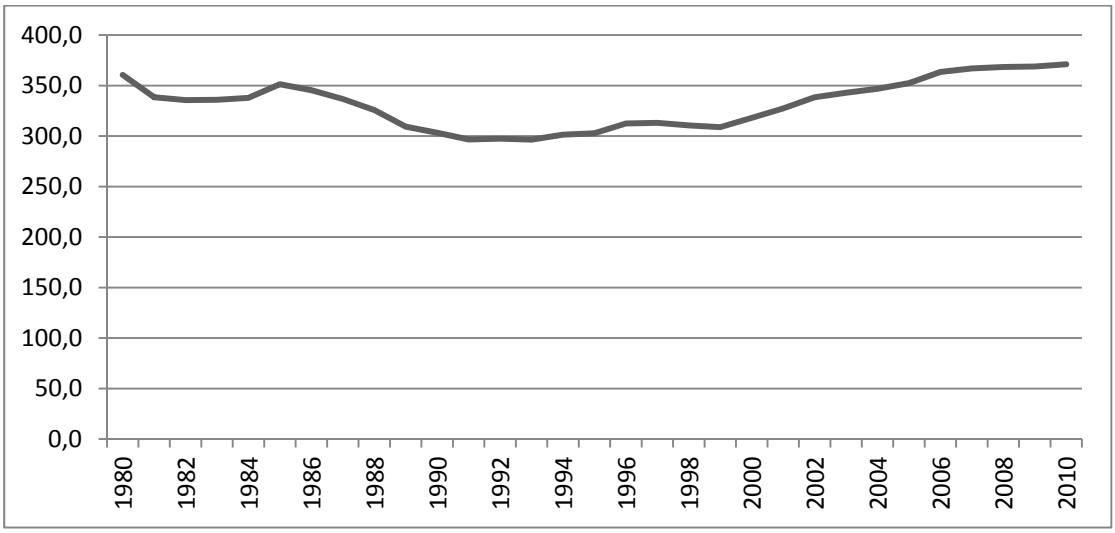


Figure 18 – Resulting R^{BN} + R^{BE} series



4 Comparison with data from previous studies

As we mentioned in the introduction there are two earlier contributions to the measurement of worker flows on the Dutch labour market Broersma and den Butter (1994) and Kock (1998) – we refer to them as B&B and Kock, respectively, in this section. The main difference between the data generated in this paper and the data in B&B (1994) and Kock (1998) is the different time ranges. B&B cover the time range 1970 to 1991, Kock covers the years 1970 to 1995, and the dataset presented in this paper covers the time range 1980 to 20010. It should be noted here that Kock is an updated version of B&B's data and construction method.

B&B and Kock also work with job flows and flows within employment, which are redundant in terms of the requirements of this paper. In addition, B&B do not work with disability data, whereas Kock does. In addition, Kock distinguishes unemployment assistance from welfare.

Although B&B and Kock used the same source for the employment stock data as this paper, there are some remarkable differences between the different stock data series, as illustrated in Figure 19a. This is mainly because the CBS has changed the definition for the unemployment series over time. The same holds for the comparison of the unemployment stock data in B&B and this paper, as illustrated in Figure 19b, and for the comparison between the disability stock data in Kock and this paper, as illustrated in Figure 19d. Kock uses the unemployment data provided by the UWV, thus looking only at unemployment due to firings.

One peculiarity of B&B's and Kock's dataset is that they do not work with a published non-working population stock series. This distinctive feature of their dataset allows them to drop one restraining factor of the data generation process, i.e. having to model the changes in employment and unemployment such that the change in the not working stock is reflected. This explains the differences between the (generated) not working series illustrated in Figure 19c.

Next to differences in stock data, there are some differences between the construction methods of missing flow data; missing flow data being defined as data that is not supplied by CBS or UWV.

In this paper, persons enter the labour market when they become 15, before they leave school. This flow, consisting of persons that become 15 and immigrants, goes directly

into not working. Once one of these non-working students enters the labour market, he or she flows out of not working into employment or unemployment. In B&B and Kock, by assumption 50% of the school leavers go to employment.

Figure 19 – Comparison of stocks

Figure 19a – Employment stock

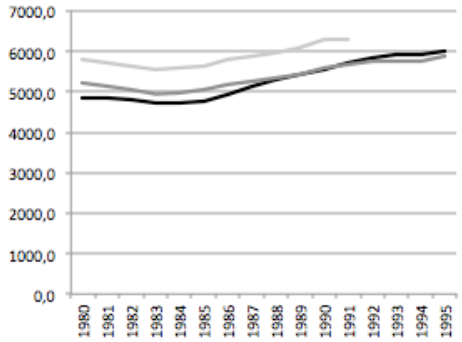


Figure 19b – Unemployment stock

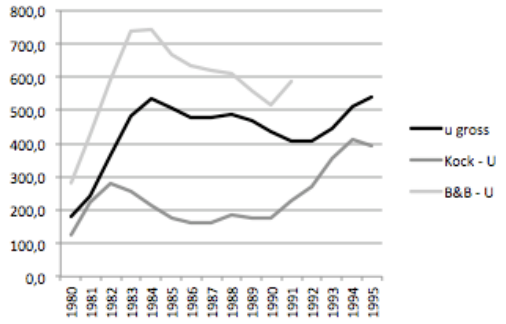


Figure 19c – Not working stock

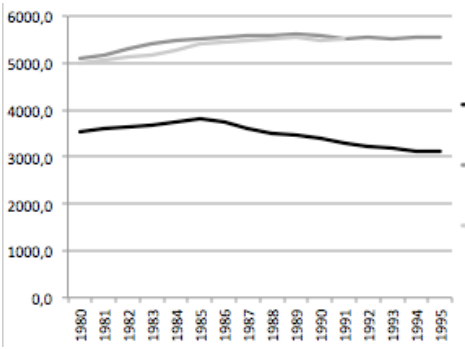
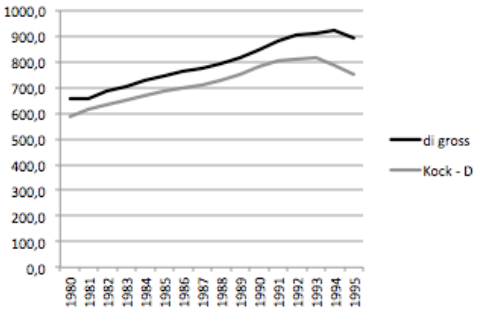


Figure 19d – Disability stock



Persons that die are shifted in B&B first into retirement (i.e. not working), where they disappear. Old-age retirement in our model is equivalent to dying, as persons that die or retire leave the relevant age group. And thus in our model, persons can die or retire in every state. In B&B, persons basically don't die formally. They are shifted into non-working, which is in itself no clearly defined entity. Kock goes a different direction by clearly defining non-working as a state, and thus by sending persons out of the working population when they die.

Although the B&B and Kock unemployment series differs from the series provided in this paper, they work with the same inflow data provided by the UWV, as shown in the comparison in Figure 20a. The series in the Figure only differ due to the difference in unemployment stock data.

This paper follows the approach outlined in section 3. We first calculate total inflow into unemployment based on a comprehensive model, and then deduct R^{EU} from that total flow to calculate R^{NU}, as illustrated in Figure 20b.

Figure 20 –Comparison of flows

Figure 20a – comparison REU

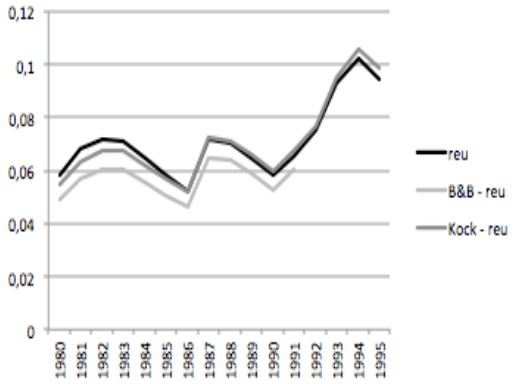


Figure 20b – comparison RNU

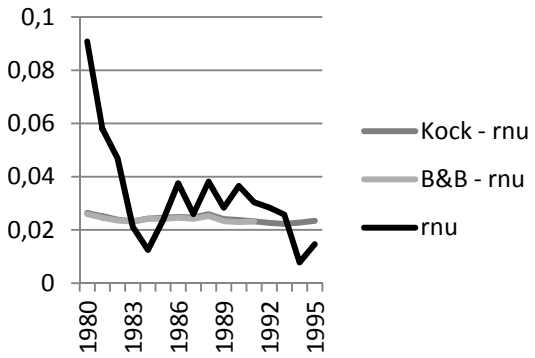


Figure 20c – comparison RUN

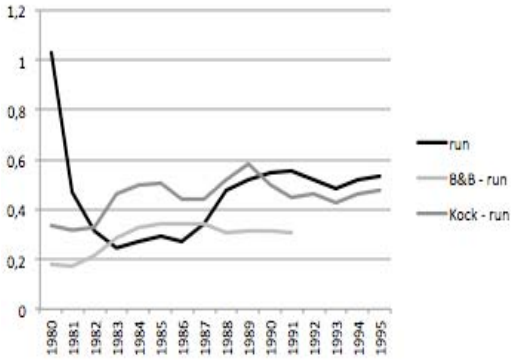
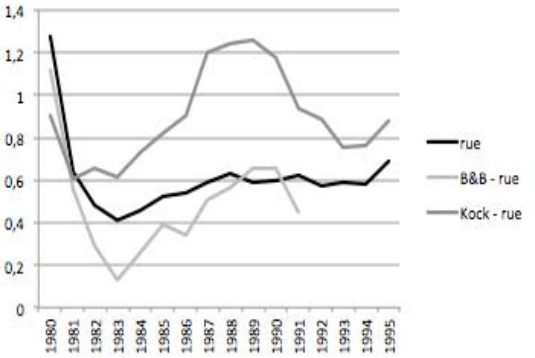


Figure 20d – comparison RUE



Although there is data on the outflow from unemployment to not working provided by the UWV Kroniek, none of the papers in this comparison uses that data. This paper follows the approach outlined in section 3, i.e. calculating total outflow from unemployment, and then subdividing that inflow into R^{UE} and R^{UN} according to the corresponding shares found in the Kroniek. B&B on the other hand assume that each year, 5% of the short-term unemployed and 50% of the long-term unemployed flow to not working. In Kock, 40% of total outflow from unemployment goes to non-participation, while the remaining 60% of total unemployment outflow is equal to the flow from welfare to employment. The series are compared in Figure 20c. The large share of R^{UN} in 1980 and 1981 reflects the very low

unemployment rates at the early 1980's, coupled with large giving-up rates around that time.

Just as unemployment outflow to non-working, the outflow to employment in this paper is calculated according to the scheme outlined in section 3. To calculate the outflow to employment, B&B subtract the flow from unemployment to working from total unemployment outflow. Total unemployment outflow in B&B is calculated on the basis of unemployment inflow, which in turn is calculated as the sum of the Kroniek flow from employment to unemployment and the outflow of school leavers to not working. In this context, one should also keep in mind that B&B don't have a formal stock variable for non-working, and thus one missing control variable. This implies that there is a bias in their data, which makes the comparison with the data generated in this paper impossible. Nevertheless, the series are shown in Figure 20d. The Figure shows that the shares of R^{UE} generated in this paper are somewhere in between the results generated in B&B and Kock.

In this paper, the net flow from E to N is generated according to the procedures outlined in section 3.4, and confirmed by the CBS's SBI data. In B&B, the flow from employment to not working consists of early retirement (CBS statistical yearbook), retirement, and persons that are shifted into disability schemes. In Kock, the R^{EN} flow goes directly into disability. This is one of the reasons why this paper's R^{EN} net flow is mostly larger than the one's in Kock and B&B. Bock Kock and B&B do not work with a set stock of the non-working labour force. In that sense, they do not need to make the model internally consistent.

Figure 21 – Comparison flows to non-working

Figure 21a – comparison REN

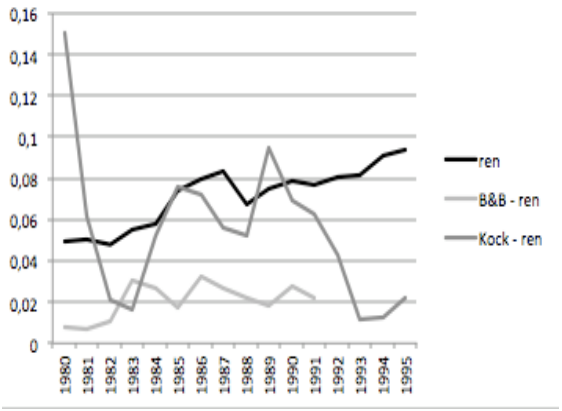
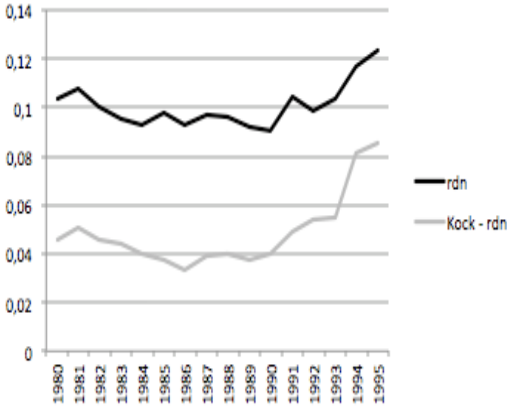


Figure 21b – Disability outflow



In Kock, the early disabled flow from non-working to disability without passing through

employment. As the flow is assumed to be very small, it will be neglected in this paper. Kock's flow of disabled to non-working is calculated as retirement plus 55 per cent of those that recover from disability. In Kock, additional 20 per cent of those that recover from disability flow to welfare, and the rest goes to employment. Kock bases these assumptions on empirical evidence from a study by the CTSV (1996). The flows from and to disability used in this paper are based on UWV data.

Overall, this section has shown that earlier constructed sets of flow data are incomparable to our series due to different sets of underlying stock data and due to different sets of underlying assumptions.

5. Comparison with SSB and LFS data and time-aggregation bias

For the period 1999 to 2008[24], flow data could be obtained based on micro data from CBS's Social Statistical Database (SSB). In addition to that, the CBS publishes a second set labour flow data based on the labour force survey in the time frame 2003 to 2010. The comparison of these data with our findings, which are on an annual basis, also enable us to shed some light on the so-called time-aggregation bias.

The "Social Statistisch Bestand" (SSB) records the income source before inflow or after outflow of a number of different benefit recipients. The SBB's sample population consists of all persons living in the Netherlands that receive work related income, a pension, or unemployment, disability or social benefit on the last Friday of September. Income out of wealth, freelance work and student benefits are not counted in this setup. The basis for the SSB dataset is administrative micro data from the social security and tax administration.

Within the SSB, a job or the recipiency of a benefit only counts if the corresponding payment is actually made (payment principle). This may cause differences with statistics that count a benefit or job when it was introduced in the administration (registration principle) or whenever the right to receiving a payment would hold (transaction principle).

For each source of income, the differences in stocks between this year's and last year's measurement date are allocated to inflows and outflows. That is, a person receiving a benefit this year who hasn't received any benefit last year is considered to be an inflow. The opposite is true for outflow measurements. Next to that this approach also takes into

[24] Due to definition changes, there is a break in series in 2005/2006.

account intra-year flows between states and more than one source of income in the course of the year. A person that has changed the status several times during the year is registered once as outflow or inflow in each affected state. Note that this approach does not cover multiple intra-year status changes. This in turn implies that the SBB data is less affected by the time aggregation bias than the LFS data.

The CBS's labour market mobility data is based the on quarterly labour force surveys (LFS), which were introduced in the Netherlands in 1987 – see also Bierings, Siermann and de Vries (2009). Since 1999, the labour force survey follows a rotating panel design with a total of 62.000 households and a maximum of 8 people per household (in 2011) that are being interviewed each quarter, in which the labour market position of the survey participants is compared to the previous time span. The sample is drawn from the population in working age, i.e. 15 to 65, with the exception of institutionalized persons. The CBS data is published on a yearly and on a quarterly basis.

One of the results of the survey is an estimate on how many persons changed their labour market position from one quarterly observation to the other, thereby following the transaction principle. The survey distinguishes between working population, unemployed and non-working population, as well as between gender, age, education, working relation, and job level. Since the method applied by the CBS only observes the start and end labour market position of the individual, all the labour market flows that happened in the meantime remain unobserved. This is in contrast to our data, which is based on administrative flows (Kroniek).

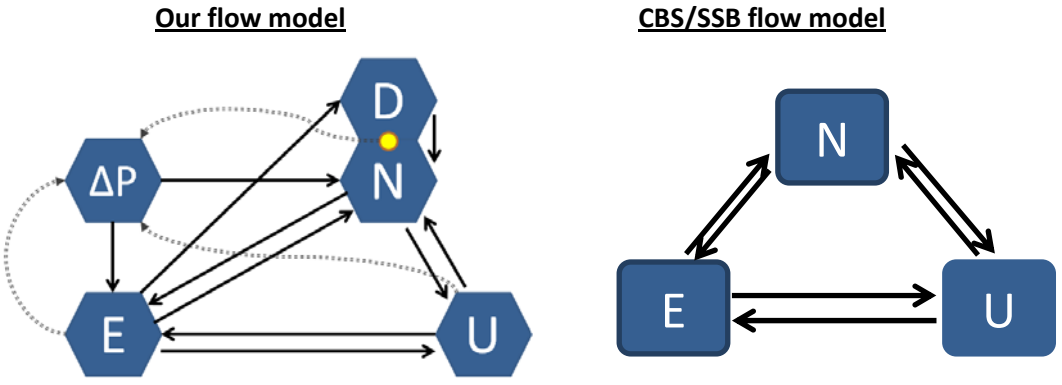
The differences between the CBS LFS and SSB data can be explained by the choice of reference date and differences in definitions and structure of the SSB, i.e. the measurement method. On top, the data sources of the SSB are broader, with more administrative sources. The unemployment definition used in the SSB counts a person as unemployment if he or she looking for a job of least 1 hour a week. In our data and in the EBB (LFS), the same person needs to be looking for a job of at least 12 hours a week to be considered unemployed. A full comparison of both data sources is provided in van den Berg and Peltzer (2011).

The data generated in our analysis consist of stock variables of different labour market states, and the flows between these states. In that sense, the setup of our data is mostly comparable with the benefit recipients data published in the SSB, with one major difference: the data captures the change in labour market status, as unrelated as possible to the change in benefit eligibility or administrative records, thereby following a deduction of the transaction principle based on the Kroniek data which used the payment principle: Instead of

counting eligibility for benefit recipiency, our model captures the official definitions for being unemployed and employed.

In order to make a comparison between the labour market mobility data and the data produced in this paper possible, we boiled down the flows to the easiest comparable common factor. Thus, we only compare flows between the labour market states E, U and N, thus counting disability as non-working. Thereby, the main difference between the datasets are the unemployment definitions and the different counting methods, i.e. the continuous measurement of our data vs. the comparisons of two points in time. The LFS data does not capture sickness and disability, as well as flows into and out of the labour force. In order to account for changes in the population, the CBS applies the rule $\Delta P_t = \Delta N_t$. In order to achieve intertemporal comparability for the time period 1980 to 2010, this paper uses existing flow data for this time period to calculate a consistent series of labour market flows. The definition of the flows thus is somewhat different as in the other data sources mentioned herein.

Figure 22 – Comparison our flow model and SBS/SSB flow model



As can be observed in the Figures below, the developments in labour market flows in all three datasets run in parallel, even though the flows in our data are consistently higher than in the yearly LFS or SSC flows. The main reason for this difference is time aggregation bias (see Shimer 2012), i.e. the consistent underreporting of the labour market flows due to the measurement method, which only compares the differences between two points in time. This implies that the labour market moves between these points in time are not tracked. This is in contrast to the method presented in this paper, which tracks all moves between all different labour market states. This is also why the differences are largest between high turnover flows.

Figure 23 – Comparison of our data with yearly time series

Figure 23a – comparison R^{EU}

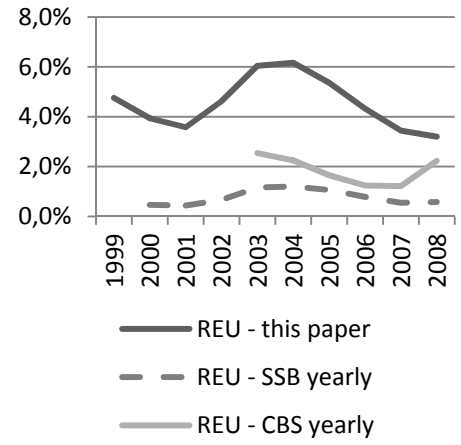


Figure 23b – comparison R^{UE}

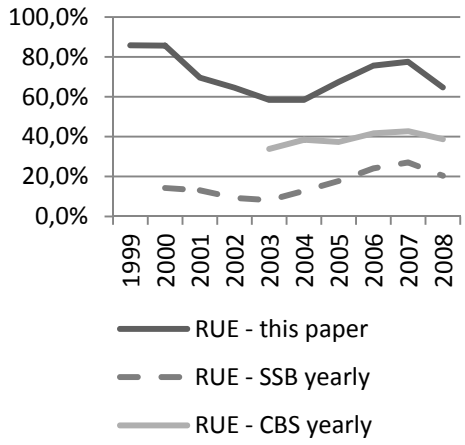


Figure 23c – comparison R^{NU}

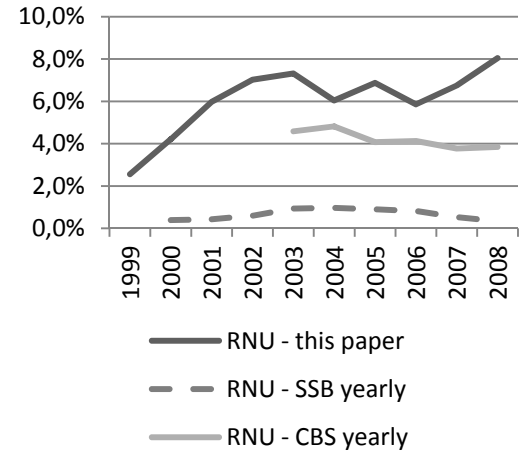


Figure 23d – comparison R^{UN}

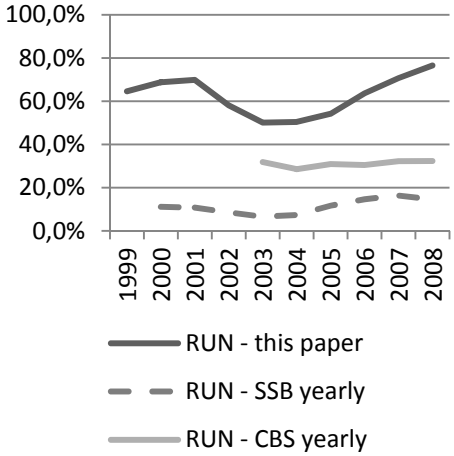
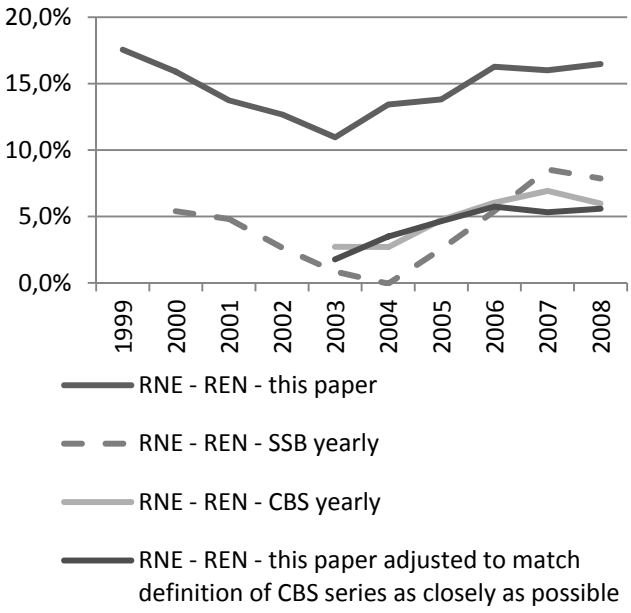


Figure 23d – comparison R^{NE}



There is a small difference between our stock data and the CBS stock data, which is due to the fact that we took geometric means to generate mid-year series, while the CBS is using end of year series. When comparing the quarterly CBS LFS data converted into yearly data using matrix multiplication to our data, a number of conclusions become clear. Overall, we can conclude that even though the levels are not the same, the trends of the net flows between states in both datasets are comparable.

Figure 24 – Comparison of net flows data with quarterly CBS LFS data

Figure 24a – comparison U to E net

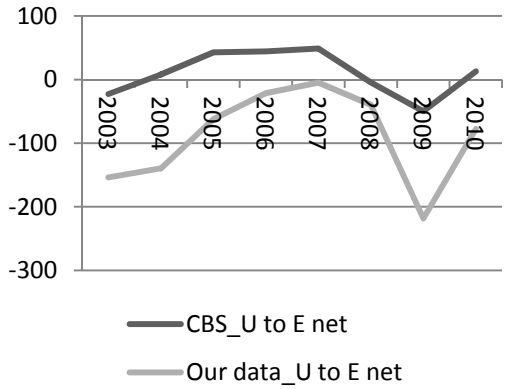


Figure 24b – comparison U to N net

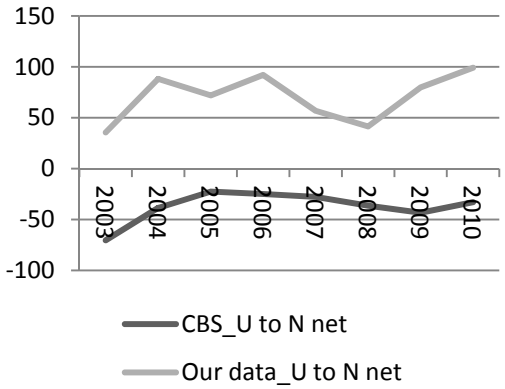


Figure 24c – comparison N to E net

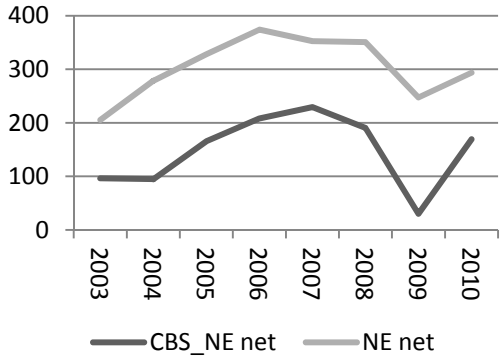
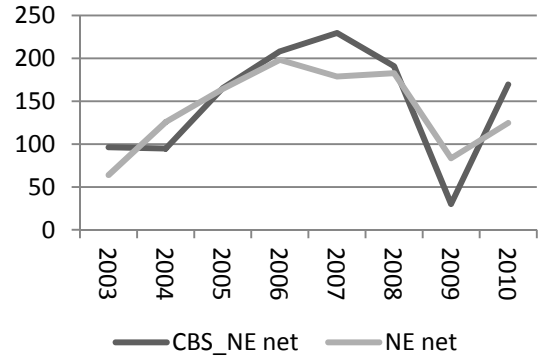


Figure 24d – comparison N to E net, adjusted for differences in datasets:



Adjusting for differences in the two datasets by subtracting the net flows into and out of the labour force from R^{NE} and R^{EN}, the N to E net flows in our dataset and the CBS LFS are almost equal. In the CBS data, there is a stronger weight on U to E net, while in our data U to N net is more emphasized. The reason for this is that in our data, we have a much larger EU flow. R^{EU} by the CBS is even smaller than our Kroniek base data, which captures unemployment benefit take-up. An explanation for this is that no one gets lost in administration. We also see

that our dataset overemphasizes the role of flows between U and E. We believe this is mainly because unemployment benefit recipients may not be looking for work, even though their status officially is "looking for work" to ensure benefit recipiency. Benefit administration is decoupled from the labour force survey. Thus, people may also claim benefits more often than they report unemployment in a survey. Overall, we believe that our setup ensures that no one that is employed will claim to be unemployed since each person entering U is at least needs to register with the UWV.

The fact that R^{NU} is relatively small can be explained by the size of R^{EU}. R^{NU} is a remainder of U inflow which is calculated in section 3.2. A small NU flow translates directly into a large U to N net flow, as we observe above.

A direct comparison of the flows in our model and the SSB/CBS data is not straightforward. The problem in this context is that the CBS is using micro data to compare the labour market position of the people in its panel at two points in time. This is where the time aggregation bias comes into action: As we mentioned above, only comparing the differences between two points in time can result in consistent underreporting of the labour market flows between those two points in time (Shimer, 2012).

Since the labour force survey data are available on a quarterly and on a yearly basis, the comparison of these data with our findings, which are on an annual basis, also enable us to confirm the presence of time-aggregation bias. Our data is continuous, which results in large flows compared the quarterly flows. For instance, the factor 2,21 found for the outflow of employment to unemployment implies that over 50 percent of the persons involved in job separations finds a new job within a quarter, without finding employment directly. We find that the factor between continuous and quarterly data is on average 38 per cent.[25] Going to yearly data, the difference increases, as might be expected.

Table 4: Average time aggregation bias, 2003-2010*:

	R^{EU}	R^{UE}	R^{UN}	R^{NU}	R^{NE} net[26]
CBS quarterly vs. yearly	1,26	1,14	1,48	1,54	2,45
Our data vs. CBS quarterly	2,21	1,58	1,37	0,82	0,94
Our data vs. CBS yearly	2,79	1,79	2,03	1,26	2,32
Our data vs. SSB (*2008)	6,82	7,51	10,00	10,09	3,13
CBS yearly vs. SSB (*2008)	2,45	4,19	4,92	8,00	0,52

[25] As Nekarda (2009) finds: "Gross flows estimated from monthly data understate the true number of transitions by between 15 and 24 percent." Bruil, den Butter, and Kee (2011) show that in the Dutch context, continuous measurement of labour market flows increases the labour market dynamics about three-fold compared to measurements in discrete time-spans.

[26] CBS comparison adjusted for differences in datasets.

6. Concluding Remarks

In this paper we presented data on stocks and flows in the labour market for the period 1980 – 2010, constructed using various sources. These data complement the data published by the CBS, since our findings are based on administrative measurements of worker flows, whereas the CBS compares labour market positions between various periods. Moreover, our data go back to 1980, whereas the CBS data start in 1999. Our results are different from those found in the pioneering study Broersma and den Butter (1994) and its companion study Kock (1998) because we use revised data and extend the data set to administrative data instead of social security data which are more limited in nature. Next to that we use different assumptions based on more recent insights and cover a longer time period. Hence we provide a unique data set which can be used to analyse labour market flows in the Netherlands over a longer time period.

A drawback of our approach is that we were not able to find quarterly data. Fortunately this does not create a time aggregation bias in the data because the administrative data we use provide continuous measurements. But the short-term labour market dynamics will be hard to measure.

Another drawback is that we have no data on the time dimension of jobs and other characteristics of the jobs or persons involved. As a consequence we cannot analyse the increased incidence of part-time work in the Netherlands and the increased flexibilization of the labour market with a growing share of precarious jobs and (involuntary) self-employed persons – see van Galen et al. (2011) for an analysis of the labour market dynamics of these groups.

However, our data will enable researchers to focus on medium term dynamics in the labour market between employment, unemployment, disability and not working. Interesting research questions in this respect which can be analysed are for instance the medium term impact of institutional changes on the participation rate in the Netherlands and on the incidence of disability. We intend to do research in that direction and hope others will use our data as well.

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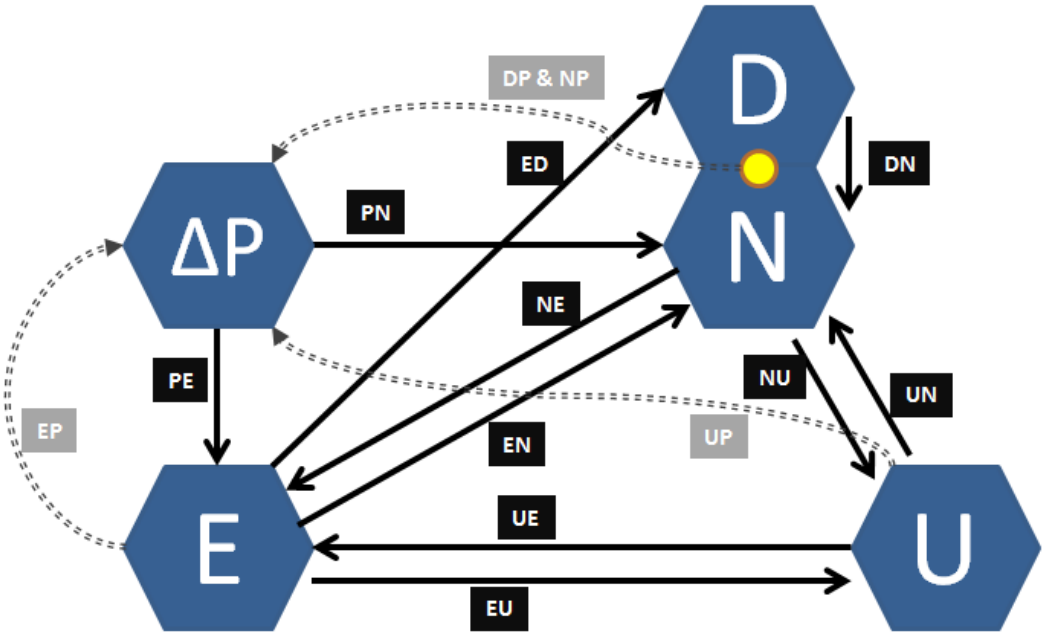
Appendix 1: List of acronyms and abbreviations

Stocks	
P	Population
E	Employment
U	Unemployment
N	Not working
D	Disability
B&B	Broersma and den Butter (1998)
BZB	Beroepszoekende zonder baan
CBS	Statline database of Statistics Netherlands
CCS81	New unemployment definition introduced in the 1980s
CPB	Netherlands Bureau for Economic Policy Analysis
EBB	"Enquete beroepsbevolking" – the Dutch labour force survey
GAB	Dutch Labour Office
GWL	Geregistreerde werkloosheid – registered unemployment
IOAW	Wet Inkomensvoorziening Oudere en gedeeltelijk Arbeidsongeschikte werkloze Werknemers – Support for older and party disabled unemployed
RWW	Rijksgroepsregeling Werkloze Werknemers – Unemployment benefits for recipients > 1 year
SWZ	Ministerie van Sociale Zaken en Werkgelegenheid – Dutch Ministry of social affairs
UWV	Uitvoeringsinstituut Werknemersverzekeringen – Unemployment benefit administration authority
Wajong	Wet arbeidsongeschiktheidsvoorziening jonggehandicapten –Disability insurance for young people
WAO	Wet op de arbeidsongeschiktheidsverzekering – Disability insurance
WAZ	Wet arbeidsongeschiktheidsverzekering zelfstandigen – Disability insurance for self-employed
WBB	Werkloze beroepsbevolking – Jobless labour force
WIA	De wet Werk en inkomen naar Arbeidsvermogen – Disability insurance programme from 2004 onwards.
WRR	Scientific Council for Government Policy
WULBZ	Wet uitbreiding loondoorbetalingsverplichting bij ziekte
WW	Werkloosheidswet – unemployment insurance
WWV	Wet Werkloosheidsvoorziening – long term unemoployment insurance
WZB	Werkzoekende zonder baan – Job seekers without employment
ZW	Ziektewet – Sickness insurance

Appendix 2: Stock flow accounting equations

Figure 25 – The flow model outlined



The four states are mutually exclusive, so total working age population is given as:

$$P = E + U + D + N$$

Through demographic s and migration each period there is inflow and outflow in the population. By assumption population inflow can only occur in in states E and N, so

$$R^{PU} = R^{PD} = 0$$

As a consequence

$$\Delta P = I^{P} - O^{P} = (R^{PE} + R^{PN}) - (R^{EP} + R^{UP} + R^{DP} + R^{NP})$$

Outflow from the working-age population is assumed proportional to the population in a state, see (eq. 1, p. 12), so

$$R^{SP} = O^{P}\, S/P \text{ for any state } S = \{E, U, D, N\}$$

The stock-flow equation equations for the four states are given as

$$\Delta E = I^{E} - O^{E} = (R^{UE} + R^{DE} + R^{NE} + R^{PE}) - (R^{EU} + R^{ED} + R^{EN} + R^{EP})$$

$$\Delta U = I^{U} - O^{U} = (R^{EU} + R^{DU} + R^{NU}) - (R^{UE} + R^{UD} + R^{UN} + R^{UP})$$

$$\Delta D = I^{D} - O^{D} = (R^{ED} + R^{UD} + R^{ND}) - (R^{DE} + R^{DU} + R^{DN} + R^{DP})$$

$$\Delta N = I^{N} - O^{N} = (R^{EN} + R^{UN} + R^{DN} + R^{PN}) - (R^{NE} + R^{NU} + R^{ND} + R^{NP})$$

In line with the institutions, inflow into disability can only occur when participating in the labour market, hence $R^{ND} = 0$. The scheme above illustrates all this.

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